

GLY4310

56 points

Name _____

February 6, 2020

4- took exam - Numbers to the left of the question number in red are the number of incorrect responses. Instructor comments are in blue.

Florida Atlantic University

PETROLOGY -- MIDTERM ONE KEY

True-False - Print the letter T or F in the blank to indicate if each of the following statements is true or false. Illegible answers are wrong. (1 point each)

- 4 T 1. The micas are examples of triphormic phyllosilicates. *From Mineral Powerpoint, slide 78, "Micas -Another example of triphormic phyllosilicates"*
- 0 T 2. Feldspathorids often include unusual anions such as Cl^- , CO_3^- .
- 1 F 3. Petrology is the "Branch of geology dealing with the description and systematic classification of rocks, especially igneous and metamorphic rocks, and especially by means of microscopic examination of rock thin sections."
- 4 F 4. When seismic waves (both P and S) enter the asthenosphere, their velocity initially increases. *Waves slow down in less rigid materials*
- 1 T 5. Chemical analysis of the crust and whole earth shows the silicon has a substantially higher value (weight %) in the crust than the whole earth.
- 1 F 6. The Widmanstatten Pattern in meteorites is found only in stony meteorites. (Hint: What causes the pattern?)
- 0 T 7. Primary igneous structures form during solidification, and result from interactions between mineral crystals and melt.
- 0 T 8. Minerals whose structures are relatively simple, such as the oxides or olivine, nucleate more easily than those with complex structures, such as calcic plagioclase feldspar.
- 0 F 9. Rapid cooling allows the system to maintain thermodynamic equilibrium.
- 0 T 10. Typically, maximum growth rate occurs at somewhat higher temperature than maximum nucleation rate.

- 1 F 11. For a crystal growing in magma, more liquid is available to a point on the edge of the crystal than to the corner of the crystal.
- 3 F 12. In reverse zoning, lower temperature minerals surround a higher temperature core (i.e. albite around anorthite)
- 1 T 13. Early stage minerals are often euhedral.
- 2 T 14. Early formed crystals may react with the melt to produce a new mineral surrounding the outside of the crystals. This is called a reaction rim.
- 4 F 15. Presolidification deformation can produce undulatory extinction in quartz. [Read the question - what is "presolidification"?](#)

Multiple-Choice - Choose the best response to each statement or question. Print the letter corresponding to your choice in the blank. (1 point each)

- 1 D 1. Which of the following processes is affected by heat loss?
A. Crystallization
B. Melting
C. Metamorphism
D. All of the above
- 0 D 2. If $(Al_2O_3) \approx (Na_2O) + (K_2O)$ a rock may be described as:
A. Metaluminous
B. Peralkaline
C. Peraluminous
D. Subaluminous
- 0 D 3. Elements found in the core of the earth most likely belong to which of the following Goldschmidt classifications?
A. Atomophile
B. Chalcophile
C. Lithophile
D. Siderophile
- 1 B 4. Which of the following minerals is hydrous?
A. Diopside
B. Hornblende
C. Labradorite
D. Nepheline

- 2 C 5. What is the first step in classifying a rock using the IUGS classification procedure?
A. Determine if the rock is silica excessive (QAP diagram) or silica deficient (FAP diagram)
B. Determine if the rock is phaneritic (intrusive) or aphanitic (extrusive)
C. Determine the mode
D. Use the correct diagram to determine the rock name
- 2 C 6. Pyroclastic particles with a predominant size range of 2 to 64 mm should be called:
A. Block
B. Bomb
C. Lapilli
D. Tuff
- 1 B 7. Rocks in which most of the crystals are euhedral would be described as:
A. Hypidomorphic
B. Idiomorphic
C. Lineated
D. Xenomorphic
- 0 D 8. When large K-spar crystals grow around existing minerals, what type of texture is produced?
A. Graphic
B. Granophyric
C. Ophitic
D. Poikilitic
- 1 A 9. When a hydrous magma reaches the surface, the hydrous phase may be rapidly lost. Hydrous phenocrysts dehydrate and oxidize. A ring of pyroxene and iron oxides around amphiboles are an example. This is called:
A. Dehydration rim
B. Embayed texture
C. Sieve texture
D. Trachytic texture
- 2 A 10. Cluster textures result from crystals remaining in suspension. When of multiple-grain clusters of adhering phenocrysts, which may be different minerals, form, it is called:
A. Cumulophyric
B. Glomeroporphyritic
C. Perthitic
D. Synneusis

- 0 B 11. Perthite and antiperthite are examples of textures produced by?
A. Deformation
B. Exsolution
C. Liquid immiscibility
D. Partial remelting
- 0 C 12. Ocelli are produced by:
A. Deformation
B. Exsolution
C. Liquid immiscibility
D. Partial remelting
- 3 B 13. A post-crystallization reaction involving water is known as a deuteritic reaction. A reaction which involves the conversion of feldspars to a very fine-grained white mica (essentially muscovite) is called: [The mica is called sericite](#)
A. Saussuritization
B. Seritization
C. Serpentization
D. Uralization
- 3 D 14. Another type of deuteritic reaction involves pyroxenes, which are anhydrous. At lower temperatures, they may react with water to produce an amphibole. The replacement can be as reaction rims, patches of pyroxene left in amphibole, or complete replacement. This is called:
A. Saussuritization
B. Seritization
C. Serpentization
D. Uralization
- 0 D 15. Silicate minerals make up approximately what percent of the earth's crust?
A. 32
B. 52
C. 72
D. 92

Fill-Ins - Write in the word or words which best completes each statement or answers each question. (1 point per blank)

- 2 1. Some minerals nucleate on a preexisting crystal of another mineral. The crystal structures of both crystals must be similar. This type of growth overcomes the problems of nucleation in an open magma, and is called EPITAXIAL growth.

- 3 2. Plutonic intrusive rocks cool very slowly, and pass through the temperature regime usually associated with metamorphism (300-800°C) slowly enough that reactions may occur. These reactions are called AUTOMETAMORPHIC reactions.
- 3 3. A vitric tuff on the pyroclastic classification chart will consist mainly of fragments of what? GLASS. [What does vitric mean?](#)
- 2 4. Minerals, like biotite or hornblende in granite, which may be present but are not required are known as ACCESSORY minerals.
- 3 5. Perthite is described as, “The host is K-spar, with albite lamellae appearing as a coherent intergrowth.” What does the term coherent mean, as it is used here?
COHERENT MEANS THE EXTOLLED PHASE LATTICES HAVE A SPECIFIC RELATIONSHIP TO THE HOST LATTICE
- 3 6. What is the color index of a rock that contains 30 to 60% dark minerals? MESOTYPE

Matching I - Match the description in column one with the correct silicate subclass in column 2. (1 point each) Answers may be used once, more than once, or not at all.

Column 1

Column 2

- 2 E 1. The epidote group is the most important group in this subclass, which has an Si:O ratio of 2:7.
- 2 F 2. Many important felsic mineral groups, including silica, feldspar, and feldspathoid belong to this subclass, with an Si:O = 1:2.
- 0 B 3. The pyroxene, pyroxenoids, and amphibole groups belong to this subclass, with Si:O for these groups = 1:3, 1:3, and :2.75, respectively.
- 1 D 4. Brittle micas and clays belong to this subclass, with Si:O = 2:5.
- 1 C 5. The olivine group, including the olivine series, and garnet group belong to this subclass, with Si:O = 1:4.
- 1 F 6. This subclass is composed of three-dimensional framework silicates, which results in stable, strongly-bonded structures.
- 2 A 7. Gem minerals with hexagonal prismatic habits, including emerald, aquamarine, and morganite, belong to this subclass, with Si:O = 1:3.

- A. Cyclosilicate
B. Inosilicate
C. Nesosilicate
D. Phyllosilicate
E. Sorosilicate
F. Tectosilicate

Discussion questions - Write a complete, concise answer to each of the following questions. Diagrams (labeled) may be used to supplement your written answers, where appropriate, and must be shown where requested. Points as shown

- 7.5 1. What group does augite belong to? What group does hornblende belong to? How can small crystals of these two minerals be distinguished? (3 points)

Augite is a pyroxene, while hornblende is an amphibole. Small, dark crystals of these minerals may be distinguished on the basis of cleavage. Augite - 2D@90°, hornblende 2D@90°.

- 10 2. Fully explain the classifications phormic (ie. diphormic, triphormic) and octahedral (again, di and tri). What silicate subclass are they used with. (3 points)

They describe different types of phyllosilicates. Phormic refers to the number of layers, so diphormic is a two layer phyllosilicate consisting of a tetrahedral and an octahedral layer, while a triphormic phyllosilicate consists of a t-o-t structure. Octahedral refers to the number of octahedrally coordinated sites are occupied. There are three possible sites. A dioctahedral phyllosilicate has two of the three sites occupied by trivalent cations. A trioctahedral phyllosilicate has all three of the sites occupied by divalent cations.

9 3. Goldschmidt's classification of elements is useful, but there are problems. Explain the following: (3 points)

1. Iron is found in the core, but is also found in silicates and sulfides. What Goldschmidt affinities do these represent? Why does iron exhibit three different affinities?
2. Why aren't all elements that prefer to be in sulfide phases found there?

The core contains siderophile elements. Silicate phases are lithophile, whereas sulfide phases are chalcophile. Many atoms are ionized, and each ion has its own individual preferences. Iron can be metallic (charge = 0) but can also be ferrous or ferric. Each oxidation state has its own affinity. Many chalcophile elements are found in other associations because there is insufficient sulfur to combine with all chalcophile elements.

3 4. Why is magma erupted at a continental rift zone, such as the East African rift, much more alkaline than magma erupted at a mid-ocean ridge? (1 point)

Magma erupted at a continental rift zone has risen through, and assimilated, some of the continental crustal rock, which is considerably more alkaline than the original magma.

- 4.5 5. In both the Inosilicate groups Amphibole and Pyroxene, both orthorhombic and monoclinic structures exist. Explain what causes the difference in structure. (It is the same cause in both groups). 2 points

Pyroxenes have two distinct divalent cation sites, M1 and M2. Amphiboles have four sites, M1 through M4. If the sites are all filled with cations which Goldschmidt's rules tell us can freely substitute for each other, little or no ordering of cations on any particular site will occur. This is usually Mg^{2+} and Fe^{2+} . This produces an orthorhombic structure. If one cation is considerably larger, such as Ca^{2+} , it will preferentially occupy the largest available site, producing order, and lowering the symmetry to monoclinic.

- 8 6. Dendritic crystals, with a highly-branched structure, may form for two reasons. What are they? (2 points)

Dendritic growth may occur because an attempt by the crystal to find a source of appropriate ions, or to shed the heat of crystallization, or both.

- 11 7. Secondary twinning may result from two different processes. Name and describe the two processes. (3 points)

Secondary twinning may result from polymorphic transformation, or from deformation.

Transformation twins result from a high-temperature polymorph inverting to a lower-temperature form as cooling proceeds. High-temperature forms are usually higher symmetry than lower temperature structures. Upon cooling, the high symmetry structure has a choice of two or more lower symmetry structures. If two or more structures are actually produced, they commonly bear a twin relationship to each other.

Deformation twins result from the shifting of grains as crystallization proceeds. Plagioclase and calcite are two common minerals exhibiting this behavior. Deformational albite twins characteristically "pinch out" rather than running throughout the grain. They may also be bent. They enhance ductility in some rocks, such as marble

Previous Results

2020 - 52.1%
2019 - 68.8%
2018 - 68.5%
2017 - 85.3%
2016 - 78.9%
2015 - 69.5%
2014 - 75.8%
2013 - 77.1%
2012 - 81.3%
2011 - 77.5%
2010 - 76.2%
2009 - 70.4%
2008 - 81.9%
2006 - 78.6%
2001 - 73.3%
1999 - 76.0%
1998 - 81.6%
1997 - 79.8%
1996 - 84.3%
1995 - 82.0%
1994 - 76.1%
1993 - 87.1%
1992 - 87.3%
1991 - 80.0%

